

ENERGY AUDIT FOR THE UMP LIBRARY AND ENERGY EFFICIENCY  
PROJECT PROPOSAL

AHMAD SYAKIR BIN MOHAMAD

UNIVERSITI MALAYSIA PAHANG

# UNIVERSITI MALAYSIA PAHANG

## BORANG PENGESAHAN STATUS TESIS♦

JUDUL: ENERGY AUDIT FOR THE UMP LIBRARY AND ENERGY EFFICIENCY PROJECT PROPOSAL

SESI PENGAJIAN: 2008/2009

Saya AHMAD SYAKIR BIN MOHAMAD  
(HURUF BESAR)

mengaku membenarkan tesis (Sarjana Muda/~~Sarjana~~ /~~Doktor Falsafah~~)\* ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Malaysia Pahang (UMP).
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. \*\*Sila tandakan ( √ )

☐

**SULIT**

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

☐

**TERHAD**

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

☒

**TIDAK TERHAD**

Disahkan oleh:

\_\_\_\_\_  
(TANDATANGAN PENULIS)

\_\_\_\_\_  
(TANDATANGAN PENYELIA)

Alamat Tetap:

970E, JALAN HOSPITAL,  
15000 KOTA BHARU,  
KELANTAN.

NORHAFIDZAH BINTI MOHD SAAD  
( Nama Penyelia )

Tarikh: 17 NOVEMBER 2008

Tarikh: : 17 NOVEMBER 2008

CATATAN:

\*

Potong yang tidak berkenaan.

\*\*

Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh tesis ini perlu dikelaskan sebagai atau TERHAD.

♦

Tesis dimaksudkan sebagai tesis bagi Ijazah doktor Falsafah dan Sarjana secara Penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM).

“I hereby acknowledge that the scope and quality of this thesis is qualified for the  
award of the Bachelor Degree of Electrical Engineering (Power System)”

Signature : \_\_\_\_\_

Name : NORHAFIDZAH BINTI MOHD SAAD

Date : 17 NOVEMBER 2008

ENERGY AUDIT FOR THE UMP LIBRARY AND ENERGY EFFICIENCY  
PROJECT PROPOSAL

AHMAD SYAKIR BIN MOHAMAD

This thesis is submitted as partial fulfillment of the requirements for the award of the  
Bachelor of Electrical Engineering (Power Systems)

Faculty of Electrical & Electronics Engineering  
Universiti Malaysia Pahang

NOVEMBER, 2008

I declare that this thesis entitled “*Energy Audit for the UMP Library and Energy Efficiency Project Proposal*” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : \_\_\_\_\_

Author : **AHMAD SYAKIR BIN MOHAMAD**

Date : **17 NOVEMBER 2008**

## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	TITLE PAGE	i
	DEDICATION	ii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	x
	LIST OF FIGURES	xi
	LIST OF ABBREVIATIONS	xiii
	LIST OF APPENDICES	xiv
<b>1</b>	<b>INTRODUCTION</b>	
	1.1 Overview	1
	1.2 Objectives of Project	3
	1.3 Scopes of Project	4
	1.4 Thesis Outline	4
<b>2</b>	<b>LITERATURE REVIEW</b>	
	2.1 Introduction	6
	2.2 A study on energy wasting	6
	2.3 Energy Audit	7
	2.3.1 Commencement of Energy Audit	8
	2.4 The Site Survey	9
	2.4.1 Energy Sources	9

2.4.2	Energy Utilization	9
2.4.3	Energy Control	10
2.5	Energy Audit Programmer	10
2.6	Energy Efficiency	12
2.6.1	Electrical Energy Efficiency	12
2.7	Efficient and Effective Lighting	13
2.8	Energy Efficiency with Lighting	15
2.9	Idea of Energy Concept	16
2.10	Power Factor	17
<b>3</b>	<b>METHODOLOGY</b>	
3.1	Introduction	20
3.2	Flow Chart of Energy Audit at UMP Library and Energy Efficiency Project Proposal	21
3.3	Selection of Building for Case Study	24
3.4	Auditing Procedure for Electrical Energy	25
3.4.1	Power Consumption Auditing	25
3.4.2	Power Factor Auditing	30
3.5	Equipment Survey	31
3.5.1	Lighting Survey	31
3.6	Energy Conservation Recommendation	32
3.6.1	Simulation by Visual Basic	32
3.6.1.1	Starting with Visual Basic	32
3.6.2	Simple Payback Period	39
3.7	Conclusion	39
<b>4</b>	<b>RESULT AND ANALYSIS</b>	
4.1	Introduction	40
4.2	Comparison Study of Energy Consumption at UMP Library	40
4.2.1	Voltage Supply	41
4.2.2	Current Consumption	42
4.2.3	Power Factor	43

4.2.4	Apparent Power	44
4.2.5	Real Power	46
4.2.6	Reactive Power	47
4.2.7	Summary of parameter measured	48
4.3	Power Factor Analysis	48
4.3.1	Installation and Cost Analysis	48
4.3.2	Power Factor Recommendation	50
4.3.3	Simple Payback Period	51
4.3.4	Discussion on Power Correction in UMP Library	52
4.4	Lighting Retrofit	52
4.4.1	Relamping Fluorescent Lamp	52
4.4.2	Observation / Perspective	54
4.4.3	Lighting Retrofitting Scheme Recommendation	57
4.4.4	Simulation (Visual Basic 6.0)	57
4.4.5	Discussion of Lighting Retrofit	59
<b>5</b>	<b>CONCLUSION AND RECOMMENDATION</b>	
5.1	Conclusion	61
5.2	Future Recommendation	61
	<b>REFERENCES</b>	62
	<b>APPENDICES</b>	
	APPENDIX 1	64
	APPENDIX 2	69
	APPENDIX 3	75
	APPENDIX 4	79



**LIST OF TABLES**

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Luminance Levels	14
2.2	Efficacy ranges of available lamps	15
4.1	Summary of differential between existing and improvement system	48
4.2	Improved system with power factor correction for UMP Library main switch word (MSB)	50
4.3	Cost comparison electronic versus magnetic ballast	60

## LIST OF FIGURES

FIGURE	TITLE	PAGE
1.1	Front view of UMP Library	2
1.2	Excessive lighting systems at rack reference book	3
2.1	Three fundamental component energy management process	16
2.2	Power Triangle	18
3.1	Flow chart of this project	22
3.2	Front view of UMP Library	24
3.3	Side view of UMP Library	25
3.4	ELITE pro power meter	26
3.5	Clamping the three channel in comer at MSB	26
3.6	First stage to log the data	27
3.7	Channel setup parameter	27
3.8	Three phase and four wires wye	28
3.9	The result are measure in channel form	29
3.10	The result in graph	29
3.11	The main switch board (MSB) at UMP Library	30
3.12	Installation of Capacitor Bank in UMP Library	31
3.13	Opening dialog windows VB	33
3.14	Example form of project	34
3.15	The toolbox form	34
3.16	The view of frame in the fore	35
3.17	The textbox and label in the frame of project	35
3.18	The properties of frame project	36
3.19	Frame of existing and propose lighting system	36

3.20	The background and types font selected	37
3.21	The label and textbox selected	37
3.22	New frame at the same form	38
3.23	Part of coding.	38
4.1	Average voltage for phase B (existing system)	41
4.2	Average voltage for phase B (improved system)	41
4.3	Current consumption for existing system	42
4.4	Current consumption for improved system.	42
4.5	Power factor for existing system.	43
4.6	Power factor for improved system	44
4.7	KVA consumption for existing system	45
4.8	KVA consumption for improved system	45
4.9	KW consumption for existing system	46
4.10	KW consumption for improved system	46
4.11	KVar consumption for existing system	47
4.12	KVar consumption for improved system	47
4.13	Electronic ballasts improve lumen maintenance	53
4.14	Lighting arranging at private site study	54
4.15	Lighting arranging at discussion area	55
4.16	Lamp arranging at rack reference books	55
4.17	Downlight at UMP Library	56
4.18	Simulation for existing and proposed new lighting equipment	58
4.19	Result of the analysis between existing and proposed system	59

## LIST OF ABBREVIATIONS

UMP	Universiti Malaysia Pahang
KUKTEM	Kolej Universiti Kejuruteraan Teknologi Malaysia
JPPH	<i>Jabatan Pembangunan dan Pengurusan Harta</i>
TNB	Tenaga Nasional Berhad
AC	Alternate Current
DC	Direct Current
MSB	Main Switch Board
LUX	I luminance Level
GUI	Graphical User Interface
VB	Visual Basic
SPP	Simple Payback Period
MD	Maximum Demand
V	Voltage
A	Ampere
Z	Impedance
W	Watt
kW / P	Kilo Watts / (Real Power)
kVA / S	Kilo VA / (Apparent Power)
kVAR / Q	Kilo VAR / (Reactive Power)
kWh	Kilo Watts per Hour
pf	Power factor
LED	Light Emitted Diode

**LIST OF APPENDICES**

APPENDIX	TITLE	PAGE
A1	View of Universiti Malaysia Pahang Library plan building	64
A2	Lighting Properties at Universiti Malaysia Pahang Library and Tariff and example Electric Tariff	69
A3	Data Summary of Energy Audit	75
A4	Visual Basic, Coding of Lighting file	79